hour at the different loads (fig. 36). This method of plotting the total water consumption was introduced by Willans, and has been of much service to engineers. It will be noticed that when the brake horse-power is zero, that is, when the engine is running " light ", a certain amount of steam is being used.

Bedplate and Oil Pump.—The chief structural function of the bedplate is to support the crank-shaft bearings and to act as the base upon which the engine is erected.

In high-speed enclosed engines it also serves as an oil tank, and the oil pump is fixed inside on the bottom. As in the case of the crank-case, the thickness of metal is usually decided by manufacturing considerations, and it may have the same thickness, or in large engines may be a little thinner. Its cellular shape makes it exceedingly strong as a structure. In very large engines the bedplate is sometimes split longitudinally for convenience in manufacture, but this is not to be recommended, as trouble may be caused by oil leaking through the joint, causing the concrete to perish. There is no cure for this except taking down and re-erecting the whole engine and cutting away the concrete which has perished. This is a serious under-taking. For the same reason, and in the interest of cleanliness, a groove or shallow well should be cast all round the bottom edge of the bedplate to catch any oil that may drip down.

On the top surface there is a thick facing strip for the crank-case joint, which helps also to stiffen the section in that neighbourhood. Doors are provided to give access to the oil pumps and strainers.

The bearing shells are always of cast iron lined with white metal and may have a thickness of $\frac{d}{} + 0{*}2$, where d is the diameter of the shaft in inches. Bronze shells are not necessary. With cast iron there is no possibility of trouble occurring by the shells closing on the shaft, owing to the difference of the coefficients of expansion of bronze and cast iron, as the metal, of course, warms up when the engine is running.

The bearing caps may be of cast iron, but some makers prefer to use cast steel. The caps act as a beam, supported at each end at the centres

of the studs. The bending moment may be taken as $\sim \frac{WL}{8}$, when L in. is the distance between stud centres, and the stress should not exceed 1000 to 1200 Ib. per square inch for cast iron and 6000 Ib. per square inch for cast steel. In taking out these stresses the full boiler pressure should be assumed on the high-pressure piston for the high-pressure bearing caps, due allowance being made for the distance between the centre of the crank-pins and the centres of the respective bearings. For the other bearing caps the greatest load due to working conditions including overload should be taken from indicator diagrams of similar engines, regard being given to the sequence of crank&, in triple engines especially, and the total load that may come upon one cap should be taken. Allowance should be made for the hole for the oil pipe in the cap. Studs are invariably used, and the stress